The Effects of Behavior-Based Support Services on Social Communication Among High School Students with Autism Spectrum Disorder

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Abstract

This study used propensity score techniques on data from the National Longitudinal Transition Study-2 to assess the causal relationship between speech and behavior-based support services and rates of social communication among high school students with Autism Spectrum Disorder (ASD). Findings indicate that receptive language problems were significantly reduced among students with ASD who received behavioral and family support services. These results provide practitioners, advocates, and families with a clearer national picture of the linkage between behavior-based services and their impact on social communication outcomes, and illustrate the importance of these services in improving the social communication skills of adolescents with ASD.

Introduction

As autism spectrum disorders (ASD) become more prevalent in society, greater advances in research, advocacy, and support services have resulted in a greater likelihood of children with ASD having successful academic careers in secondary and even postsecondary educational settings, and the goal of attaining success in a these settings become increasingly realistic (Hart, Grigal, & Weir, 2010). Yet even among youth with high functioning ASD who have the cognitive capacity to achieve academic success in secondary and postsecondary education, many continue to face numerous challenges that prevent them from reaching their full potential.

One particular challenge arises from their inability to fully comprehend and engage in social communication. With the exception of classic autism, in which there is a severe delay or total lack of spoken language, speech/language therapies for those on the moderate to higher functioning range of ASD focus predominantly on the social use of expressive language, referred to as pragmatics, and the basis for the newly defined diagnosis of social communication disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013). While pragmatic language is a key component of social communication, it is is just one of several facets of language development that affect individuals with ASD. A precursor to pragmatics, and in essence the foundation for all forms of verbal, non-verbal, and written communication, is receptive language, that is, the ability to understand and decode speech and language (Dockrell & Messer, 1999).

Individuals with ASD generally have poor receptive language skills that may improve but continue to persist into adolescence and adulthood (Ballaban-Gil, Rapin, Tuchman, & Shinnar, 1996). In fact, a recent study found that receptive language skills were actually weaker than expressive language skills among individuals with ASD, suggesting that those with ASD appear to

understand less than what their verbal abilities would imply. These results run counter to the trends seen in neurotypical individuals or those with other disabilities that impair language development, such as intellectual disabilities, who generally show equivalent or higher expressive language aptitude relative to receptive language (Maljaars, Noens, Scholte, & van Berckelaer-Onnes, 2012). Such findings suggest that therapies should be proactive about increasing receptive language skills if they are to truly improve the social communication of people with ASD.

Indeed, given the fact that social communication skills are necessary to promote the reciprocal interaction between students and teachers, and students and peers that are essential to learning (Banda & Kubina, 2010; Donaldson & Zagler, 2010), it is particularly important for schools to provide the necessary services and interventions to effectively support language development among students with ASD. Traditionally, interventions meant to treat any type of language impairment, particularly those involving expressive language skills, typically fall under the purview of speech and language therapists (Fleming, Miller, & Wright, 1997). However, it appears that some of the most effective services that can benefit social communication in students with ASD may actually come from behavioral interventions. The National Autism Center's Standards Report (2009) revealed that the most established treatments shown to have positive influence on social communication were typically behavior-based supports, such as applied behavior analysis or behavioral packages derived from functional behavior assessments. Frequently, behavioral interventions also include a family component, as studies suggest that incorporating a parent focus may also result in positive impacts on youth social engagement and communication (Bauminger, 2002; Herbrecht, 2009, Laugeson, 2009, White 2010a; White 2010b).

However, there are still a number of knowledge gaps that limit our understanding of effective interventions as they pertain to the social communication of individuals with ASD. Most studies that investigate the effectiveness of supports and services on social communication tend to focus on pragmatic language or the social responsiveness of individuals with ASD, and far less is understood about the impact an intervention may have on receptive language, or the ability to understand what is being said to them. Additionally, studies that evaluate the efficacy of a certain therapy or intervention tend to use clinic-based samples, when the reality is that half of the students with ASD who receive behavioral interventions do so in school settings (Wei, Wagner, Christiano, Shattuck, & Yu, 2013). Oftentimes, these studies are limited by small sample sizes, short follow-up periods, and a lack of randomization or control groups. Furthermore, the majority of studies that focus on language development of individuals with ASD tend to focus on young children and, in a similar vein, most interventions supporting speech and language development generally serve elementary-aged children (Kjellmer, Hedvall, Fernell, Gillberg, & Norrelgen, 2012; Ray-Subramanian & Weismer, 2012; Wei et al., 2013). However, social communication skills also play a critically important role during adolescence, as this is the time when many individuals begin exploring their personal identities in relationship to others, forge stronger relationships outside of immediate family members, and look to peers for socialization (Steinberg, 2001).

This study aims to fill some of these knowledge gaps by using propensity score modeling on a large-scale, nationally representative dataset to determine whether school-based interventions impact adolescents with ASD's social communication via receptive language, that is, the ability to understand what is being said to them. The interventions selected for this study included speech

and language therapies, behavioral interventions for the youth, and training and support services provided to the family.

Methods

Sample

Conducted by SRI International for the U.S. Department of Education, The National Longitudinal Transition Study-2 (NLTS2) is the largest and richest dataset available that generalizes nationally to the experiences of youth with disabilities as they transitioned from high school to adulthood. The NLTS2 two-stage sampling strategy first randomly sampled local educational agencies (LEAs) and state-supported special schools stratified by geographic region, district enrollment, and wealth (i.e., Orshansky profile). Students receiving special education services were randomly selected from rosters of LEAs or special schools. Each student's eligibility for special education services and the designated disability category were determined by the LEA or special school contributing the student roster. Details of the sampling strategy for NLTS2 were previously published (Wagner, Kutash, Duchnowski, & Epsiten, 2005). Approprite analysis weights (described in the methods section) were used to produce estimates tht generalize to all students receiving special education services and to those in a given age range and disability category.

Participants

The initial NLTS2 sample included more than 11,000 high school students ages 13 through 16 and receiving special education services on December 1, 2000, with about 1,100 of them received special education services in the autism category through the Individuals with Disabilities Education Act (IDEA). (Bertrand et al., 2001; Yeargin-Allsopp et al., 2003).

The present study used data from wave 1 of youth with ASD or their parents through a telephone interview, self-administered mail survey, or school program survey. Data were collected on an original sample of 960 youth with an ASD. Population estimates are based on weights that take into account young adult and LEA characteristics used as stratifying variables in the sampling. Unweighted sample sizes in this paper were rounded to the nearest ten, as required by the U.S. Department of Education.

Intervention Variables

The intervention variables analyzed in this study were extracted from the school program survey and dichotomously coded: (1) speech/language therapy received by the youth in the past school year, (2) behavioral interventions received by the youth in the past school year, and (3) training, counseling, or other support services received by the youth's family in the past school year.

Outcomes

Social communication via receptive language was defined as a student's ability to understand others in a social context. The outcome is based on parent-reported incidence of any problems they believe the youth has in understanding conversations with other people, where 1=yes and 0=no. To ensure that "understanding" refers to receptive language comprehension and not listening comprehension, respondents were removed if they indicated any physical characteristics that may impair their hearing.

Covariates

Demographic variables reported by parents or students' school districts included youth's gender, age, race/ethnicity, family income, mother's education level, whether or not parents ever attended postsecondary education.

Disability severity was measured using several variables: parent reported expectation that the youth will attend postsecondary education; parent reported Attention Deficit Disorder (ADD); children's social skills score from the Social Skills Rating Systems (SSRS)-parent version (Gresham and Elliott 1990), which asks about tasks such as whether the child joins groups, end disagreements calmly, keeps working until finished (alpha=0.79); functional cognitive skills score based on parents' reports of how well their child managed tasks such as telling time and counting change (alph=0.93); and self-care skills score based on two items: how well youth dresses and feeds him or herself..

Youth academic achievement was measured by secondary school grade point average (GPA) extracted from the transcript data, whether youth took an alternative assessment instead of the standardized achievement assessments, and the number of credits earned in general education classes.

Propensity Score Methodology

Propensity score techniques have been increasingly used in observational studies with cohort or case-control designs to reduce selection bias in estimating intervention effects when randomized controlled trials are not feasible or ethical (Rosenbaum & Rubin, 1983, 1984, 1985). This study used propensity score methods to test the effect of speech/language therapy, behavioral intervention, and family counseling/support services on the odds of decreasing social comprehension problems. The propensity score is the predicted probability of participating in these behavior-based interventions based on a set of potentially confounding covariates (e.g., student demographic and disability characteristics, student academic achievement) using logistic regression. This method strives to create balance on observed covariates between treatment and

comparison using statistical methods instead of randomization. The goal is to achieve a valid test of the treatment effect while statistically balancing intervention particpants and nonparticipants on measured covariates, thus disentangling confounding effects from treatment effects. The extent to which this goal is achieved is indicated by identifying antecedent variables that might be expected to relate to outcomes and comparing their distribution in the treatment and control groups. If they are relatively similar, one can use the antecedent variables as covariates and allow the regression to adjust for the relatively modest differences in those covariates between the two groups.

Analyses presented here estimated the average treatment effect on the treated (ATT) in the NLTS2 sample of students with ASD. For these analyses, we adjusted for confounding using an inverse propensity score estimators as recommended by Curtis and colleagues (2007), Hirano and colleagues (2003), and Rosenbaum and Rubin (1983). Specifically, the weight for treated students was 1.0 and the weight for nonparticipating students was equal to their propensity score transformed to an odds scale ($p_i/1\text{-}p_i$) (Harder, Stuart, & Anthony, 2010; Hirano et al., 2003).

The ATT of the interventions were estimated using a weighted logistic regression model. The odds ratio from each model can be interpreted as the measure of association between the interventions and outcomse adjusted fro the estimated propensity of participation. This essentially weights the comparison group to create balance with the treatment on observed covariates and thus estimate the effect of participation for those individuals who actually participated. Weighting was selected over other approaches, such as matching, because of its good performance in this dataset (details below), flexibility with the distribution of the data, its ability to deal with time-dependent covariates and censored data, and because it retains all subjects in the analysis.

To ensure that the method was successful at creating covariate balance, we compared the standardized mean difference between participants and nonparticipants before and after propensity

score weighting for each covariate. The standardized mean difference is the difference in means between the groups, divided by the pooled standard deviation of both the treatment and comparison group.

Handling of Missing data

Missing rates for covariates ranged from no missing to 52%. Missing data on covariates were imputed using Stata ICE (Imputation by Chained Equations) procedure (Royston, 2004, 2005a; Royston, 2005b; Royston, 2007, 2009; Royston, Carlin, & White, 2009) to impute 20 implicates. ICE first imputes values for a single variable given a set of predictor variables using a regression approach, and then cycles through all of the variables to be inputed. The regression is ordinary least squares if the variable being imputed is continuous, logistic if the variable is binary, multinomial logistic if categorical, or ordinal logistic if ordered multinomial. ICE imputes values for missing observations by drawing from the posterior predictive distribution of each variable. Imputations were performed on all variables used in the analyses to avoid bias associated with listwise deletion and to capture the information contained in the correlation between covariates and the outcome and treatment variables. However, as recommended by Little (1992), Little and Rubin (2002), White et al. (2011), and Von Hippel (2007), we did not use imputed values for the outcomes or treatments in the analyses. Analyses conducted on imputed data were aggregated using the Stata mim procedure, a command for analyzing multiple imputed datasets, which combines regression results across implicates and adjusts the standard error estimates to reflect uncertainty in the values of imputed data.

Results

Table 1 shows the characteristics of youth with ASD weighted to represent the population.

Consistent with epidemiological estimates, 85.4% of youth were male. The sample was diverse in terms of ethnicity, race, and family socioeconomic position. Parent education level was generally high, with 71.4% of parents ever attending postsecondary education. Less than half (43.9%) received a direct assessment score, emphasizing that this was not a predominantly high functioning group of youth with an ASD. The percent of youth with an ASD who received speech and language therapies was 68.2%; behavioral interventions was 36.3%; and family-based training, counseling, and support services was 26.6%. The rate of having any difficulty understanding others was 77.4%.

<Table 1>

To ensure that the propensity score method successfully created balanced treatment and comparison groups, we compared the standardized mean differences between the two groups for each covariate before and after propensity score weighting. The standardized mean difference is the difference in means between the groups, divided by the pooled standard deviation of both the treatment and comparison group. As depicted in Table 2, after propensity score weighting, the average differences in covariates ranged from -0.09 to 0.25, all within the What Works Clearinghouse cutoff of 0.25 for baseline equivalence for quasi-experimental studies (What Works Clearinghouse, 2008). Therefore, participants and nonparticipants were similar on all potentially confounding covariates. Covariates used in propensity scoring also are included in the outcome models to further control for group differences in determining outcomes.

<Table 2>

The results of the propensity scoring analyses revealed that fewer students with an ASD were reported to exhibit receptive language problems when they received a behavioral intervention compared to students with an ASD who did not receive such an intervention. These differences in

the sample estimates were significantly different (OR=0.50, $p<.05$). Similarly, propensity adjusted rates for the sample estimates of students with an ASD whose families participated in training, counseling, and support services also revealed a decreased likelihood of exhibiting receptive language problems when compared to students whose families did not participate in such services (OR=0.45, $p<0.05$). While the results of speech/language therapies were also consistent with a decrease in receptive language problems, this finding did not appear to be statistically significant.

Discussion

These findings indicate that receptive language problems were significantly reduced among high school students with an ASD who received behavioral and family support services. Such findings illustrate the importance of these types of services to improve the social communication skills among adolescents with ASD, yet fly in the face of research that shows a generally decline in service use over time for youth with ASD (Goin-Kochel, Myers, & Mackintosh, 2007). In fact, a recent study suggests that these particular services are some of the least received among high school-aged youth with ASD, with only a quarter or less of students in high school receiving such services (Wei et al., 2013). Therefore, an important implication of our finding is the need to continue providing behavioral and family-based support services for adolescents with ASD if we expect them to improve their receptive language skills.

These results provide practitioners, advocates, and families with a clearer national picture of the causal linkage between behavior-based services and their impact on social communication outcomes. The national sampling frame, large size and diversity of this sample increases external validity and further strengthen the findings of this study. The use of propensity score methods is innovative and strengthens the causal interpretation for the association between social

communication outcomes and relevant interventions in high school. The extensive list of covariates included in both the propensity score weighting procedure and ATT estimation not only ensures the participants and non-participants were similar on as many aspects as possible, but also allow the ATT effect of service receipt to be more robust.

Nonetheless, there are a number of limitations that should be taken into account while interpreting these findings. First, unobserved confounding is a concern in propensity score modeling. This is a situation where there is an unmeasured factor that might be correlated with both the likelihood of participation and the likelihood of the outcome. In addition, the secondary nature of the data analysis does not allow us to disaggregate the specific types of interventions received from these interventionists and therapists; therefore, we are unable to speak to any specific type of intervention and its causal link with social communication outcomes. Next, the outcome variable for receptive language is based on parent surveys rather than clinical diagnosis of receptive language deficits. The potential reporting bias of parent responses may be particularly impactful on the findings pertaining to family support services, as this finding may be a reflection of the parent's ability to understand his/her child better more so than the child's actual improvement in receptive language. Future studies would benefit from the ability to use objective data, such as school and medical records to identify validated measures of language and communication deficits and to parse out specific interventions used by the specialists and interventionists that administer these social communication interventions.

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Table 1

Descriptive Analysis of Youth with an ASD

Variables Used in this Study	Full Sample		
	Unweighted n	Weighted Percent or Mean	s.e.
Covariates			
Male, %	960	85.38	2.00
African American, %	960	21.97	0.94
Hispanic, %	960	10.03	0.85
Age			
13, %	960	7.43	1.53
14, %	960	27.74	3.00
15, %	960	23.05	2.49
16, %	960	25.49	2.84
17, %	960	16.29	2.13
Income			
Low: ≤US $ 25,000, %	900	25.32	1.03
Medium: US $25,001 - US $ 50,000, %	900	28.99	0.93
High: > US $50,000, %	900	45.69	0.84
Mother's education level			
Less than high school, %	900	8.30	1.27
High school graduate or GED, %	900	25.29	2.62
Some college, %	900	33.94	2.95
B.A. or higher degree, %	900	32.47	2.73
Parent ever attended postsecondary education, %	890	71.41	2.28
Has ADD/ADHD, %	950	34.64	2.55
Social skills scale score	930	11.32	0.15
Mental functioning skills	910	10.94	0.24
Had a direct assessment score, %	960	43.93	3.16
Self-care skills	910	6.97	0.08
High school GPA	460	3.03	0.07
Credits earned in general education classes%	410	58.00	0.03
Intervention			
Speech/language therapy, %	500	68.23	5.49
Behavioral intervention, %	500	36.31	4.84
Family training, counseling or other support/services %	400	26.60	4.46
Outcome			
Problems understanding others (receptive language), %	890	77.41	2.41

Note: ASD = Autism Spectrum Disorder; GED= general education development; ADD = attention deficit disorder; GPA = grade point average.Source: NLTS2, wave 1. Percentages were weighted to population levels. Unweighted N was rounded to the nearest 10.

Table 2

Treatment and Control Balance Statistics on Covariates After Propensity Score Weighting for ATT Students in the Sample

Covariates	Speech/language therapy			Behavioral intervention			Family training, counseling, supports/services		
	Treatment	Weighted Control	Balance Statistics	Treatment	Weighted Control	Balance Statistics	Treatment	Weighted Control	Balance Statistics
Male, %	81.82	76.65	0.13	83.11	81.09	0.052	80.00	79.20	0.02
African American, %	29.20	32.53	-0.073	22.08	20.35	0.043	26.32	26.07	0.006
Hispanic, %	11.60	16.95	-0.159	13.61	10.72	0.09	14.74	15.96	-0.03
Age	15.08	15.13	-0.044	15.02	15.01	0.008	15.08	15.09	-0.007
Income low, %	29.97	38.98	-0.193	27.82	24.58	0.074	31.02	31.69	-0.014
Income medium, %	28.20	25.58	0.059	29.31	30.00	-0.015	28.85	29.42	-0.012
Mother's education level	2.87	2.53	0.119	2.87	2.91	-0.041	2.95	2.93	0.017
Parent ever attended postsecondary education, %	70.23	55.82	0.094	72.20	74.51	-0.052	70.02	69.04	0.021
Has ADD, %	28.21	20.64	0.173	33.75	37.98	-0.088	38.16	38.36	-0.004
Social skills scale score	10.71	10.60	0.03	10.12	10.11	0.003	10.98	10.99	-0.001
Mental functioning skills	9.58	8.74	0.209	9.54	9.64	-0.022	10.20	10.21	-0.003
Had a direct assessment score, %	39.09	31.99	0.147	31.83	30.83	0.022	41.05	39.81	0.025
Self-care skills	6.85	6.42	0.081	6.72	6.67	0.03	7.06	7.07	-0.009
High school GPA	3.09	3.13	-0.057	3.00	2.97	0.046	3.08	3.08	0.002
Credits earned in general education classes	41.24	31.99	0.25	43.27	43.78	-0.014	47.50	47.52	-0.001

Note: ATT= average treatment effect on the treated; ADD = attention deficit disorder; GPA = grade point average.

Source: NLTS2, waves 1 through 5. Balance statistics are measured by the standardized mean difference, which is the difference in means between the groups, divided by the pooled standard deviation of both the treatment and comparison group.

Table 3

ATT Effect of Support Services on Rate of Receptive Language Problems for Youth with an ASD

Intervention	Treatment	Control if Matched Perfectly[1]	Propensity Adjusted OR[2] [95% CI]
Speech/language therapy	79.35	82.18	0.67 [0.34, 1.31]
Behavioral intervention	72.83	83.43	**0.50*** [0.28, 0.93]
Family training, counseling, supports/services	71.41	82.27	**0.45*** [0.23, 0.89]

* $p < .05$

[1] The percent positive for a control group that would ield an unadjusted OR equal to the propensity adjusted OR; calculated as 100 * Pt/[OR(1-Pt)+Pt)] where Pt is the percent of the treatment group with a positive outcome and OR is the propensity adjusted OR.

[2] Propensity adjusted OR controlled for demographic, disability, academic, and parent expectation covariates in the weighted logistic regression model.

Note: ATT= average treatment effect on the treated; ASD=Autism Spectrum Disorder; OR = odds ratio; CI=confidence interval.

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